

## Bottle Container with Protective Membrane

### BACKGROUND OF THE INVENTION

#### 1. Field of the invention

The invention relates to a bottle container with nanoscale titanium dioxide (TiO<sub>2</sub>) photocatalyst coating and a protective film unliable to detach, and in particular, to a bottle container with a protective film that can prevent the bottle container from oxidative degradation and can strongly bind nanoscale titanium dioxide (TiO<sub>2</sub>) photocatalyst in the surface of the bottle container, such that the container can exhibit functions of killing bacteria, de-odoring and promoting absorption efficiency of UV or stronger light in sunlight.

#### 2. DESCRIPTION OF THE PRIOR ART

Hop components in beer is very sensitive to strong light such that, upon irradiated by the sunlight, the temperature will be increase and the taste of beer may become poor. The main reason comes from the degeneration of the hop component by the UV light to generate odor. Therefore, current beer manufacturers use dark polyethylene terephthalate (PET) to contain beer on the purpose of shielding from strong light. However, in case of sufficient light, the shielding effect is poor. Further, dark brown or green glass bottles used to contain beer not only are difficult to be recycled and high cost consuming, but also can not retain the intact taste of beer. Nanoscale titanium dioxide (TiO<sub>2</sub>) per se is a relatively good material for the absorption of UV light. The above-mentioned disadvantage can thus

be improved by dip-coating the bottle container with nanoscale titanium dioxide (TiO<sub>2</sub>).

Conventional bottle containers such as those disclosed in ROC Patent Publication Nos. 397050, 373624 and 319211 (the recited patent  
5 hereinafter) related mostly to improvements on the structure of the bottle container or belonged to utility model.

Conventional photocatalyst product such as those disclosed in ROC Patent Publication Nos. 482694 (the recited patent hereinafter) was a product provided with photocatalyst film containing low temperature curable  
10 oxide of high activity therein, and was characterized in that the surface of the object exposed to indoor light source or outdoor sunlight might form a coating with TiO<sub>2</sub> microparticles distributed thereon, wherein said coating film is incorporated with at least one element selected from the group consisting of Na, Li, K, Mg, Ca and Sr having a electronegativity of less  
15 than 1.6, and a ion radius of less than 0.2 micron, and wherein said elements with their ions having a valence of less than 2 is present in an amount of 0.5 to 20 wt%.

Furthermore, ROC Patent publication No. 495384 (the recited patent hereinafter) disclosed a composite material capable of decomposing one or  
20 more compound selected from the group consisting of nitrogen oxides, ammonia and sulfur dioxide within air in the environment exposed to water, and comprised at least a substrate and a surface layer, wherein said surface layer was a hydrophilic layer exhibiting self-cleaning ability and was composed of:

component (i)- a nanoscale  $\text{TiO}_2$  photocatalyst that functions as a catalyst upon exposure to light;

component (ii)- one or more metal oxide selected from the group consisting of  $\text{Al}_2\text{O}_3$ ,  $\text{ZnO}$ ,  $\text{SrO}$ ,  $\text{BaO}$ ,  $\text{MgO}$ ,  $\text{CaO}$ ,  $\text{Rb}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$  or  $\text{P}_2\text{O}_5$ ; and

component (iii)- one or more metal oxide selected from the group consisting of  $\text{SiO}_2$ ,  $\text{ZrO}_2$ ,  $\text{GeO}_2$  and  $\text{ThO}_2$ .

In viewing features of the above-mentioned recited patent, improvements needed thereof are found as follow:

- 10 1. No improvement for preventing the degeneration of the liquid contained in the bottle container was found.
2. No protection effect on the coating from the bottle container such as a polyester (PET) bottle was emphasized.
3. No improvement was done on the promoting possibility of the  
15 absorption efficiency of UV light or strong light by the bottle container.

In view of the forgoing, the inventor had devoted to improve and innovate, and finally, after studying intensively for many years, developed successfully the bottle container according to the invention.

## **SUMMARY OF THE INVENTION**

One object of the invention is to provide a bottle container exhibiting a function of preventing the degeneration of the liquid contained therein.

5 Another object of the invention is to provide a bottle container capable of promoting the absorption of UV light or visible light in the sunlight.

Yet another object of the invention is to provide a bottle  
10 container provided with a protective film to prevent the oxidative decomposition of the material used to produce the bottle.

A bottle container that can achieve the above-mentioned  
15 objects comprises a surface layer coated with a composition, said surface layer comprising a photocatalyst protective layer, containing nanoscale titanium dioxide  $\text{TiO}_2$  and being doped with copper particles to promote the absorption efficiency of UV light or strong light in sunlight,  
20 wherein a alcohol-based compound is added in the solvent of the photocatalyst coating composition, and wherein said alcohol-based compound is applied over the surface of said bottle container or object made of other organic material to prevent the bottle container or organic material from being oxidized by the nanoscale titanium dioxide ( $\text{TiO}_2$ )  
25 photocatalyst.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

The drawings disclose an illustrative embodiment of the present invention which serves to exemplify the various advantages and objects hereof, and are as follows:

5 Figure 1 is an exploded view illustrating the photocatalyst film provided in the bottle container with a protective film according to the invention; and

Figure 2 is a schematic view illustrating the oxidation-reduction reaction occurred on the surface of the bottle container according to the invention  
10 under the light irradiation.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Referring to Fig. 1, an exploded view illustrating the photocatalyst film formed on the bottle container, a catalyst is composed of a titanium  
15 dioxide ( $\text{TiO}_2$ ) material 21 having a particle size of 5 to 30 nanometers and a copper particle 22 to enhance the catalytical ability of said nanoscale titanium dioxide ( $\text{TiO}_2$ ) photocatalyst. The copper particle 22 supported on surface of the titanium dioxide ( $\text{TiO}_2$ ) material 21 can direct electrons  
4, lower greatly the re-combination between electrons 4 from titanium  
20 dioxide and pairs of electric hole 5, and increase the absorption efficiency of UV light 3 or strong light in sunlight. Since the nanoscale titanium dioxide ( $\text{TiO}_2$ ) photocatalyst exhibits colorless, odorless and non-toxic features, and does not participate itself in the reaction, there is no consumption on this catalyst. During the physical reaction by

photocatalysis, its performance is specially outstanding and obvious in decomposing various hazardous airborne substances and organic matters.

Since bottle container 2 made of polyester (PET) is also an organic material, as the nanoscale titanium dioxide ( $\text{TiO}_2$ ) material 21 is coated  
5 over the surface of the bottle container 1, bottle container 2 made of polyester (PET) itself may be decomposed also by this material 21. It is the critical aspect of the invention to avoid the oxidative decomposition of the polyester PET material by the nanoscale titanium dioxide ( $\text{TiO}_2$ ) material 21 during photocatalytical physical reaction. This is achieved by  
10 incorporating an alcohol-based compound in the solvent used in the titanium dioxide coating composition such that, after heating at 80-180°C, this compound can form on the outer layer of the PET bottle container 2 a protective film 23 that is based mainly on silicon dioxide ( $\text{SiO}_2$ ) and is strong and unliable to detach such that the contact between the polyester  
15 material and the photocatalyst can be prevent and hence to protect the bottle container 2 from being oxidized by the nanoscale titanium dioxide ( $\text{TiO}_2$ ) photocatalyst.

Referring to Fig. 2, a schematic view illustrating the occurrence of a oxidation-reduction reaction on the light irradiated surface 1 of the bottle  
20 container 1, when sunlight or UV light 3 irradiates on the surface 1 of the bottle container, they will be absorbed and generates electrons 4 and electric holes 5, and results in the reaction of water and oxygen in air into active oxygen  $\text{O}_2^-$  and hydroxyl free radical  $\text{OH}^\bullet$ , and these processes as

oxidation-reduction, absorption of incident sunlight or UV light 3, and reactions of water and oxygen in air will be carried out constantly. When this is applied on the plastic beer bottle, more than 95% of incident UV light 3 can be prevent from entering the bottle such that UV light 3 can not  
5 enter into the beer contained in the bottle, and as a result, the hop component in the beer will not be oxidized and hence the intact taste of the beer can be retained. Further, the strong oxidation ability of the active oxygen and hydroxyl free radical generated in the reaction can oxidize and decompose airborne bacteria and odorous substances so to achieve the  
10 self-cleaning effect. Likewise, the invention is applicable also on the light sensitive bottle container provided with a protective film for containing fruit juice beverage.

Accordingly, the invention has several advantages over conventional articles:

- 15 1. It can prevent the degeneration of the liquid contained therein.
2. It can increase the absorption efficiency of sunlight or UV light.
3. It can prevent the material used to produce the bottle container from being oxidized.

Many changes and modifications in the above described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, to promote the progress in science and the useful arts, the invention is disclosed and is intended to be limited only by  
5 the scope of the appended claims.